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Nevada Test Site

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THE SPENT FUEL TEST PROJECT
CLIMAX GRANITIC STOCK, NEVADA TEST SITE*

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ABSTRACT

The Spent Fuel Test-Climax (SFT-C) is a test of dry geologic storage of spent nuclear reactor fuel. The SFT-C is located at a depth of 420 m in the Climax granitic stock at the Nevada Test Site of the U.S. Department of Energy. Eleven canisters of spent commercial PWR fuel assemblies are to be stored for 3 to 5 years. Additional heat is supplied by electrical heaters, and more than 800 channels of technical information are being recorded. The measurements include rock temperature, rock displacement and stress, joint motion, and monitoring of the ventilation air volume, temperature, and dewpoint.

KEYWORDS

Nuclear Waste Disposal, Spent Fuel Storage, rock mechanics, mined repository for radioactive waste, thermal stress in rock.

TEST DESCRIPTION

The Lawrence Livermore National Laboratory (LLNL) as a participant in the Nevada Nuclear Waste Storage Investigations (NNWSI) program is responsible for the technical direction of a test of geologic storage of spent reactor fuel. This test (generally referred to as the Spent Fuel Test-Climax or SFT-C) is at a depth of 420 m in the Climax granite at the Nevada Test Site. The NNWSI is part of the commercial waste management activities of the National Waste Terminal Storage (NWTs) program of the U.S. Department of Energy (DOE).

At the time the SFT-C was authorized in June 1978, there was no high level nuclear waste in deep geologic storage, even at a demonstration or pilot scale. Furthermore, the only previous such test, Project Salt Vault (Bradshaw and McClain, 1971), was in bedded salt, and no actual experience with deep geologic storage in other rock types existed. At the Nevada Test Site (NTS) of the DOE, there existed facilities both for encapsulating spent fuel assemblies in canisters suitable for underground storage and for a test layout near previously mined workings at a depth of 420 m. Therefore, a test was planned which would have both educational and demonstration value as well as address technical issues of rock response to the waste.

The technical concept for the SFT-C (Ramspott and others, 1979) provides a simulation of the thermal field of a large repository within a 15-m x 15-m repository model cell. The heat sources are 11 canisters of spent commercial PWR fuel assemblies and 6 electrical fuel-simulators in a central canister storage drift. These are supplemented by 10 electrical heaters in each of 2 adjacent heater drifts (Fig. 1). By comparison of the electrical simulators with the spent fuel, it is possible to evaluate the effects of heat alone with heat plus ionizing radiation.

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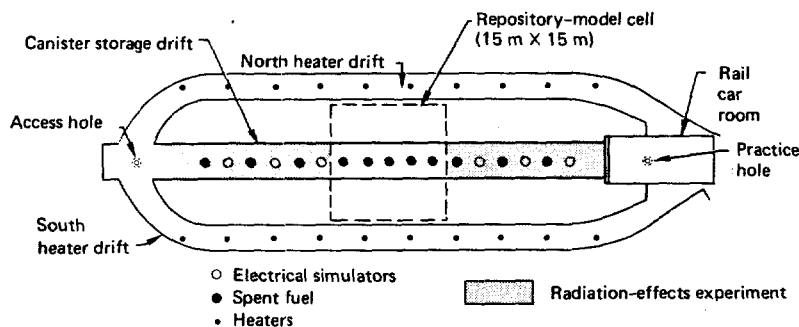


FIG. 1. Plan view of the Climax granite spent-fuel-storage test.

Spent fuel emplacement was completed by May 28, 1980, at which time the decay heat from each fuel assembly was about 1550 W. Following encapsulation at a facility about 75 km from the storage site, the canistered fuel was transported and emplaced with a system designed specifically for this test (Duncan and others, 1980). No hot cell was built at the site, and although sufficiently shielded for personnel access at all times, operations at the Climax site were remotely controlled.

With the young fuel (2.5 years out-of-core) used in this test, the thermal maxima on the storage hole walls are expected about 6 months after fuel insertion and within 2 years at edges of the 15-m x 15-m repository model cell (Fig. 1). Therefore, the test has a planned duration of 3 to 5 years. Thermal and thermomechanical calculations are documented by Butkovich (1980), Butkovich and Montan (1980), and Montan (1980).

The SFT-C underground openings were newly mined for the test. First, a 420-m deep canister access hole was drilled from the surface. Then, the two heater drifts were driven to the access hole. Prior to mining the 4.5-m x 6-m storage drift in two passes, displacement and stress instrumentation was emplaced in order to document the rock response to mining (Ramspott, 1979). These data are available for later comparison with the rock response to the thermal load. Prior calculations of both responses were made (Butkovich, 1980), and later calculations of the mining response are continuing (Heuze and others, 1980).

Prior to test construction, the geotechnical program consisted of core logging, careful mapping of the drifts, and an *in situ* state-of-stress measurement (Carlson and others, 1980). Later, measurements of rock deformability, stress, and Poisson's ratio were made *in situ* (Heuze and others, 1980).

More than 800 data channels are installed and operating. Information on the test instrumentation and some preliminary data are given by Carlson and others (1980). The technical instrumentation consists of thermocouples (487), rod extensometers (116 anchors), stress meters (18), wire extensometers (34), and 7 stations of 3-component joint-motion gages. There are also a number of manually monitored displacement pins set at various locations through the test array. Finally there is a system of ventilation and dewpoint monitors, and an array of radiation monitors.

In addition to the SFT-C, LLNL has developed a program plan for the measurement of radionuclide migration along fractures in an area adjacent to the SFT-C. We are currently carrying out field hydrologic testing in order to prepare a detailed engineering test plan. Assuming favorable results, we expect to carry out field testing with radionuclides during 1982.

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